

IV. ADDRESSING SEA-LEVEL RISE IN LOCAL COASTAL PROGRAMS

The Coastal Act requires that the 76 cities and 15 counties in coastal California prepare Local Coastal Programs (LCPs) to govern land use and development in the coastal zone above the mean high tide. LCPs become effective only after the Commission certifies their conformity with the policies of Chapter 3 of the Coastal Act.

LCPs contain the ground rules for future development and protection of resources in the coastal zone. Each LCP includes a Land Use Plan (LUP) and an Implementation Plan (IP). The LUP specifies the kinds, locations, and intensity of uses, and contains a required Public Access Component to ensure maximum public access to coastal and public recreation is provided. An IP includes measures to implement the plan, such as zoning ordinances. LCPs are prepared by local governments and submitted to the Coastal Commission for review for consistency with Coastal Act requirements.¹⁵

Once a LCP's certification becomes effective, the local government becomes responsible for reviewing most Coastal Development Permit (CDP) applications. However, the Commission retains some continuing permit authority over some lands (for example, over tidelands, submerged lands, and public trust lands) and authority to act on appeals from certain categories of local coastal permit decisions.

LCPs are essential to fully implementing sea-level rise adaptation efforts. As many of the LCPs were certified in the 1980s and 1990s, it is important that future amendments of the LCPs consider sea-level rise and adaptation planning at the project and community level, as appropriate. The California Climate Adaptation Strategy (2009) specifically identifies LCPs as a mechanism for adaptation planning along the California coast.

Steps for Addressing Sea-Level Rise in Local Coastal Programs and other Plans

The steps for addressing sea-level rise in LCPs are similar to the standard steps of a long-range planning process and should be familiar. The Commission recommends the following six steps to address sea-level rise as part of the development of a LCP, LCP Amendment, or other plan.¹⁶ These steps can be modified and adapted to fit the needs of individual planning efforts and communities and to address the specific coastal resource and development issues of a community, such as dealing with bluff erosion or providing for effective redevelopment, infill, and concentration of development in already developed areas. Local government planners should consult with Commission staff during each of these steps. The steps are illustrated in [Figure 4](#) and described below.

¹⁵ In addition there are other areas of the coast where other plans may be certified by the Commission, including Port Master Plans for ports governed by Chapter 8 of the Coastal Act, and Long Range Development Plans for state universities or colleges and Public Works Plans. Following certification by the Commission, some permitting is delegated pursuant to the Coastal Act provisions governing the specific type of Plan.

¹⁶ The guidance uses the term 'LCP process' to refer to the LCP process as well as other planning processes, including Long Range Development Plans, Public Works Plans, Port Master Plans, etc.

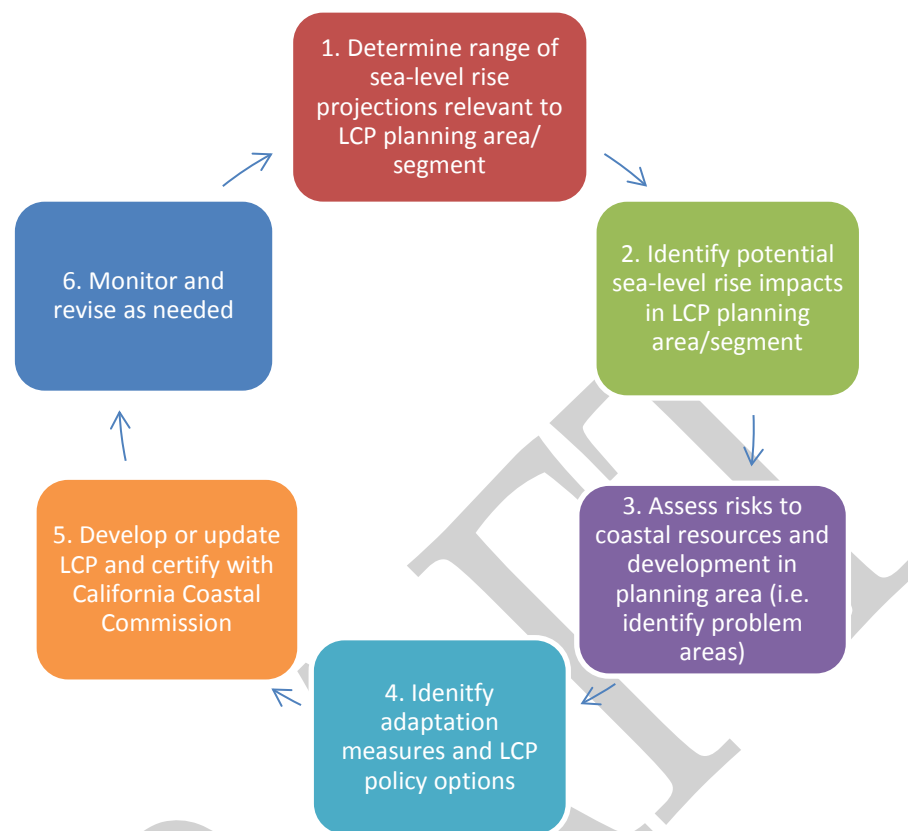


Figure 4. Sea-Level Rise Adaptation Planning Process for new and updated Local Coastal Programs

Step 1 - Determine range of sea-level rise projections relevant to LCP planning area or segments.

Follow these steps to determine the locally relevant sea-level rise projections to use in the rest of the sea-level rise adaptation planning process:

- **Determine planning horizons of concern:** The NRC report for California uses the time periods of 2030, 2050, and 2100 to project future sea levels. These ranges may be used, or local governments can identify other relevant planning horizons for their plans and development scenarios, as long as the projections for those time frames are based on the best available and relevant scientific projections.
- **Determine projections from best available science:** Using the NRC report or other comparable study, determine the range of sea-level rise for the planning horizons of concern. If those time periods extend past 2100, extrapolate from the NRC projections (See [Appendix B](#) for more details on this step). The LCP should include a policy to use the best available science about sea-level rise. Also, local governments may consider

including higher scenarios (such as a 2 meter (6.6 foot) scenario¹⁷) where severe impacts to Coastal Act resources could occur from sea-level rise.

- **For parts of the Humboldt Bay region and Eel River Estuary, modify projections for vertical land motion:**¹⁸ For project locations in the vicinity of Humboldt Bay and the Eel River Estuary, the regional NRC sea-level rise projections will need to be modified to adjust for localized vertical land motion and this is discussed further in [Appendix B](#). Adjustments for vertical land motion are not recommended for other locations.¹⁹ However, if sea-level rise projections are modified for areas other than the Humboldt Bay region, at least one scenario for the analysis of impacts should use the high value from the unmodified NRC projections.

Expected outcomes from step #1: Upon completing this step, a range of locally-relevant sea-level rise projections for the time periods of concern should be established.

Step 2 - Identify potential physical sea-level rise impacts in LCP planning area/segment.

The next step is to identify the physical hazards and impacts (referred to comprehensively as sea-level rise impacts) associated with current and future sea level. Sea-level rise impacts may include inundation, flooding, wave impacts, erosion, and saltwater intrusion. Consider how sea-level rise could interact with or exacerbate the following local water conditions: seasonal erosion, tidal range, surge, increased water levels from atmospheric forcing due to an El Niño Southern Oscillation (ENSO) or Pacific Decadal Oscillation (PDO), and waves, usually from a 100-year storm event (i.e. an eroded shoreline condition), in addition to the local sea-level rise projections. For a methodology to determine local water conditions, see [Appendix B](#).

Questions to help identify future hazards and sea-level rise impacts include:

¹⁷ The Global Sea Level Rise Scenarios for the United States National Climate Assessment 2012 establishes 2 meter (6.6 feet) as the highest global sea-level rise scenario for 2100.

¹⁸ Vertical land motion describes the subsidence or uplift of land and is caused by different processes, including tectonic activity, sediment compaction, groundwater or other fluid withdrawal and recharge, and glacial isostatic adjustment. Land North of Cape Mendocino is generally found to be rising at a rate of 1.5- 3.0mm/year, with the exception of parts of Humboldt Bay and the Eel River Estuary, which is subsiding. Land South of Cape Mendocino is subsiding at a rate of ~1mm/year, with variation in areas South of Cape Mendocino from -3.7 mm to 0.6 mm/year (NRC, 2012, pg. 78).

¹⁹ A three-member subcommittee of the OPC Science Advisory Team (OPC-SAT) advised using the NRC projections, without modification, for all California locations except between Humboldt Bay and Crescent City. The OPC-SAT subcommittee stated, "We do not believe that there is enough certainty in the sea-level rise projections nor is there a strong scientific rationale for specifying specific sea-level rise values at individual locations along California's coastline" (OPC, 2013, pg. 10).

- What are the existing flood, erosion, saltwater intrusion, water table, and coastal water quality conditions relevant to the planning area?
- What is the projected change in conditions due to locally appropriate sea-level rise projections and planning horizons of concern?

As part of the LCP, document in the Land Use Plan the current and future hazard areas in maps, GIS products, graphics, tables, charts, figures, descriptions, or other means. This process should be repeated for each planning horizon defined in Step 1. Evaluation of current and future conditions includes assessment of the following topics. [Appendix B](#) includes methodologies for these analyses.

- Current and future submerged and intertidal lands based on tidal elevations.
- Current and future cliff and beach erosion rates. For future erosion rates, modify historic cliff and dune erosion rates (see, for example, work by the Pacific Institute), to account for the influence of sea-level rise. If possible, modify long-term beach erosion rates to account for changes in sediment supply or changing transport conditions.
- Current and future flood zones and wave impacts from high tide, a 100-year storm event, elevated water level due to El Niño, etc., and seasonally eroded beach and long-term beach erosion; and from extreme events such as a greater than 100-year recurrence interval storm, a series of large storms, or a tsunami. For future flood zones, combine with the high range of locally appropriate sea-level rise projections.
- Current and future saltwater intrusion areas.
- Current and potential future coastal water pollution issues due to inundation of toxic soils, rising water tables, and increases in nonpoint source pollution.

In preparing an updated Land Use Plan, use existing models, tools, reports, historic records and other material to develop or double check the identified hazard areas. Modify the current and future hazard areas on a five to ten year basis to update planning horizons of concern and allow the incorporation of new sea-level rise science, monitoring results, and information on coastal conditions.

Expected outcomes from step #2: Upon completing this step, the potential current and future impacts should be identified based on sea-level rise projections to the planning area from sea-level rise hazards. Maps, GIS layers, graphics, figures, charts, tables, descriptions, or another system should be developed to communicate the impacts of current and future hazards.

Resources for Sea-Level Rise Mapping

[Table 4](#) includes a list of sea-level rise mapping tools. See [Appendix B](#) for additional information on determining hazard impacts and tools for mapping sea-level rise.

Table 4. Sea-Level Rise Mapping Tools

Tools	Specifics of Information	Source
Statewide		
NOAA Digital Coast Sea-Level Rise Viewer	Displays potential future sea levels with a slider bar. Communicates spatial uncertainty of mapped sea-level rise, overlays social and economic data onto sea-level rise maps, and models potential marsh migration due to sea-level rise. Maps do not include any influence of beach or dune erosion.	http://www.csc.noaa.gov/digitalcoast/tools/slrvviewer
Cal-Adapt – Exploring California’s Climate	Shows coastal areas that may be threatened by flooding from a 1.4 meter rise in sea level and a 100-year flood event. Maps do not now include any influence of beach or dune erosion or existing protective structures.	http://cal-adapt.org/sealevel/
Pacific Institute Sea-Level Rise Maps	Downloadable PDF maps showing the coastal flood and erosion hazard zones from the 2009 study. Data are overlaid on aerial photographs and show major roads. Also available are an interactive online map and downloadable maps showing sea-level rise and population and property at risk, miles of vulnerable roads and railroads, vulnerable power plants and wastewater treatment plants, and wetland migration potential.	http://www.pacinst.org/reports/sea_level_rise/maps/ For the 2009 report “The Impacts of Sea-Level Rise on the California Coast” visit: http://www.pacinst.org/reports/sea_level_rise/report.pdf
Sea-Level Rise Affecting Marshes Model (SLAMM)	Simulates the dominant processes involved in wetland conversions and shoreline modifications during long-term sea-level rise. Map distributions of wetlands are predicted under conditions of accelerated sea-level rise, and results are summarized in tabular and graphical form.	http://www.warrenpinnacle.com/prof/SLAMM

Coastal Storm Modeling System (CoSMoS)	A numerical modeling system to predict coastal flooding due to both sea-level rise and storms driven by climate change. Used in the Our Coast Our Future and for a Southern California Pilot Project. Modeling of entire Southern California Bight is expected to occur by 2014-2015, if funding is secured.	http://data.prbo.org/apps/ocof/uploads/documents/CoSMoSFAQ2013.pdf
South Coast		
Coastal Resilience Ventura	A partnership to provide science and decision-support tools to aid conservation and planning projects and policymaking to address conditions brought about by climate change. The primary goals of Coastal Resilience Ventura are assessing the vulnerabilities of human and natural resources, and identifying solutions that help nature help people.	http://coastalresilience.org/geographies/ventura-county
North Central Coast		
Our Coast Our Future (Map is available for <u>Bodega Head to Half Moon Bay</u>)	Provides online maps and tools to help understand, visualize, and anticipate vulnerabilities to sea-level rise and storms, including seamless Digital Elevation Model (DEM) at 2 meter horizontal resolution; 25 cm increment sea-level rise projections between 0 - 2 meters with a 5 meter extreme; storm scenarios using the Coastal Storm Modeling System (CoSMoS); and interactive maps overlaying infrastructure and ecosystem vulnerabilities. Learn more at www.prbo.org/ocof .	http://data.prbo.org/apps/ocof/index.php?page=ocof-map
Humboldt Bay Shoreline Inventory, Mapping, and Sea-Level Rise Vulnerability Assessment (Aldaron Laird, 2012)	This project is the first comprehensive inventory and mapping of Humboldt Bay's existing shoreline attributes: structure, cover, and elevation. An analysis was prepared of existing shoreline vulnerabilities under the current tidal regime. An existing shoreline vulnerability assessment to sea-level rise was also prepared to identify land uses and infrastructure, potentially at risk, if no mitigation measures are implemented.	http://humboldtbay.org/sites/humboldtbay.org/files/Humboldt%20Bay%20-%20Mapping%20and%20SLR%20Vulnerability%20Assessment-A.Laird.pdf

Step 3 - Assess potential risks from sea-level rise to coastal resources and development in LCP planning area/segment.

After sea-level rise impacts are identified and mapped in step 2 above, the next step is to determine whether sea-level rise poses any risks, or potential problems, for coastal resources and development in the LCP planning area. Next, assess whether the LCP planning area's current and planned land uses are feasible given those impacts, and if those land uses should be revised in response. This step requires an understanding of several characteristics of the coastal resources and development typically found within various land use types. (Much of this information can be produced in a vulnerability assessment, an analysis that is commonly conducted in the planning and climate change adaptation field. See [Appendix D](#) for a list of recent sea-level rise vulnerability assessments.)

Consider coastal development and resources, including but not limited to:

- Existing and planned development
- Coastal-dependent uses such as harbors and wharfs
- Critical infrastructure such as wastewater treatment plants, transportation infrastructure, and electricity and other energy transmission infrastructure
- Public accessways, beaches and other recreation areas, and the California Coastal Trail
- Coastal Highway 1
- Wetlands, ESHA, and other coastal habitats and sensitive species
- Ports, marinas, harbors, commercial and recreational fishing areas and facilities
- Agricultural areas
- Cultural sites and resources archeological or paleontological resources
- Visitor-serving and coastal-dependent development and uses

Conduct the following steps for each planning horizon (i.e. 2030, 2050, and 2100, or other planning horizons):

1. For the planning horizon of interest, determine what development and coastal resources may be subjected to the sea-level rise impacts expected for that time period. Map the coastal resources that lie within the sea-level rise impact areas for the given time period. (Remember to address the wide range of resources listed above, including both natural resources and development.)
2. Determine if sea-level rise impacts are a problem for each resource, and if so, to what degree the resource will be impacted. To accomplish this step, consider a wide range of characteristics of each resource, including:
 - a. **Exposure.** Will sea-level rise impacts affect the resource/development at all?
 - i. Are coastal resources and community assets exposed to sea-level rise impacts?
 - ii. Is the resource already exposed to hazards such as waves, flooding, erosion, or saltwater intrusion? If it is, will sea-level rise increase hazard exposure?

- b. **Sensitivity.** If resources are exposed, to what degree will coastal resources/development be affected by sea-level rise impacts? A simple way to think about this concept is to consider how *delicate* the resource or development is in regard to sea-level rise impacts.
 - i. How quickly will the resource respond to the impact from sea-level rise?
 - ii. Will the resource/development be harmed if environmental conditions change just a small amount? What are the physical characteristics of resource/asset? (E.g. geology, soil characteristics, hydrology, coastal geomorphology, topography, bathymetry, land cover, land use, etc.). Do any of those characteristics make the resource especially sensitive?
 - iii. Are there amounts of sea-level rise that cause sensitivity to sea-level rise to increase?
- c. **Adaptive Capacity.** How easily can the resource successfully adapt to sea-level rise impacts?
 - i. How well can the resource/development accommodate changes in sea level?
 - ii. How easily can development be modified to cope with flooding or inundation, or erosion? Can structures be elevated or relocated?
 - iii. Is rate of change faster than the ability of the resource/development to adapt?
 - iv. Are there adaptation efforts already underway? Are there any factors that limit the success of adaptation efforts?
 - v. Do wetlands and other coastal habitats have room to migrate inland? What is the overall health of existing wetlands and coastal habitats? Are there many non-climate stressors that could impair ability to adapt to sea-level rise?
 - vi. What are the options to protect, redesign (e.g., elevate), or relocate inland any existing public accessways, recreational beaches, and segments of the Coastal Trail to cope with rising sea levels? Is lateral access compromised with sea-level rise?
- d. **Consequences.** When sea-level rise has impact(s) upon a resource, what are the economic, ecological, social, cultural, and legal consequences?
 - i. How severely could the impact affect each resource? What is the scale of the impact?
 - ii. Are there cumulative consequences?
 - iii. Are there ripple effects, or secondary consequences to consider?
 - iv. Will human responses cause further adverse impacts?
- e. **Land Use Planning Options and Constraints.** Given the location of sea-level rise impacts and the resources currently located in those areas, should the kinds and intensities of land uses be changed to minimize hazards and protect coastal resources?

- i. What conditions does the land use type, development, or resource require to either exist or fulfill its intended purpose?
- ii. Is it a coastal dependent use? What is its ideal proximity to the coast?
- iii. For development, what is its economic lifespan? Is it economically feasible to locate it in a sea-level rise impact area for a certain period of time before it is removed or relocated?
- iv. For a natural resource or habitat, what conditions does it require to persist?
- v. Where should resources/development ideally be located after sea-level rise causes environmental conditions to shift?

After going through the questions listed above, synthesize the information and determine where sea-level rise impacts currently pose problems for coastal resources and how urgent those problems are. Create maps illustrating the location and extent of vulnerable land uses, such as wastewater infrastructure or State Highway 1. This information can also be summarized in narrative form. This analysis should reveal resources likely to be impacted by sea-level rise at various time steps in the future, and thus the issues that need to be resolved in the LCP planning process.

Remember that these assessments are not static; existing risks will change and new risks will arise with changes in a community, the emergence of new threats, and the implementation of adaptation actions. For this reason, the analysis should be updated as needed to reflect changes in sea-level rise projections, changes in land use patterns, or new threats.

Expected outcomes from step #3: Descriptions of the characteristics that influence risk, including exposure, sensitivity, and adaptive capacity of each coastal resource to sea-level rise impacts, along with the expected consequences of those impacts for the resource and broader community. Maps of resources and/or land uses at risk.

Example for Step 3

Consider a hypothetical planning area that hosts multiple coastal resources, including a coastal wetland, bluff-top residential development, and a wastewater treatment facility. After steps 1 and 2, you discover that portions of the planning area are subject to current and future sea-level rise impacts.

Step 3.1

Map the coastal resources (in this case the wetland, development, and wastewater treatment facility) for the range of time periods and sea-level rise projections.

Step 3.2

a. Exposure

- *Wetland:* The wetland is highly exposed to flooding and inundation from sea-level rise. By 2030, portions of the wetland will experience periodic flooding during high tides. By 2050, a portion of the wetland will become inundated and converted to open water, and by 2100 the entire area will be converted to open water. The wetland will be completely lost by this time period if it is not able to move inland.
- *Bluff-top Residential Development:* Houses in the residential development are not exposed to sea-level rise impacts in 2030. However, a high rate of erosion will put front-line houses in danger of collapse by 2050, and the entire development will be lost by 2100.
- *Wastewater Treatment Facility:* Given that the wastewater treatment plant is set back somewhat from the water, it will not be exposed to impacts from sea-level rise until 2050. By 2050, however, portions of the infrastructure will be exposed to impacts from elevated water levels due to 100-year storm events and El Nino occurrences. By 2100, significant portions of the facility will be exposed to flooding as the surrounding area is eroded and inundated.

b. Sensitivity

- *Wetland:* The wetland has high sensitivity to changes in sea level because it's functioning is highly dependent on local physical parameters such as water flow, tidal fluctuation, sediment supply, and water quality. Thus, although it currently has good sediment supply, good water quality, and a number of other characteristics, small changes in sea-level rise by 2050 may alter the function of the wetland. In addition, there are concerns that beyond 2050 the wetland will not be able to keep up with accelerated sea-level rise, thus increasing sensitivity to further changes in sea level.

Example for Step 3, cont'd

- *Bluff-top Residential Development:* The residential development has moderate to high sensitivity to longer-term sea-level rise changes. By 2050, the front-line houses will no longer be safe enough to serve as residences. Moreover, infrastructure such as roads, sewage systems, and power networks may be damaged as the bluff-face erodes.
- *Wastewater Treatment Facility:* The facility is moderately sensitive to sea-level rise. Flooding and erosion from sea-level rise could cause damage of the facility, pumps and other equipment, but it is likely that the facility is built to withstand a high degree of storm and related impacts.

c. Adaptive Capacity

- *Wetland:* The wetland has a moderate-high adaptive capacity because it has the ability to both accumulate sediment and grow upwards, and, given that the land upland of the wetland is preserved as open space, it can migrate inland. However, by 2050, a part or all of the wetland could be converted to open water if the wetland is not able to migrate inland or accumulate sediment at a rate that keeps pace with sea-level rise. Additionally, adaptive capacity may be reduced if pollution increases (for example as a result of damage to adjacent development) and disrupts the normal functioning of the wetland.
- *Bluff-top Residential Development:* The residential development has a moderate adaptive capacity. As houses become threatened over time, a scenario of managed retreat would allow houses to be relocated to safer areas. In addition, a protective structure such as a seawall would minimize threats due to erosion.
- *Wastewater Treatment Facility:* The wastewater treatment facility has a very low adaptive capacity. It is large and has expensive infrastructure so it cannot be elevated, and relocation is costly and difficult. In order to be protected in its current location, new structures will need to be built.

d. Consequences

- *Wetland:* The wetland is at moderate risk due to its high adaptive capacity. In the short term, the wetland will likely continue to function at normal levels. However, if it eventually can't keep up with sea-level rise or if there are barriers to migration, loss of the habitat will result in a loss of important ecosystem services. Essential habitat for fish and bird species will be lost, and the loss of the wetland buffer may exacerbate erosion and flooding to surrounding areas.
- *Bluff-top Residential Development:* The housing development has medium to high risk through 2100. The option to either relocate houses or protect them with a seawall means that they could continue to exist. Importantly, a system of managed retreat will allow for the continued existence of the fronting beach whereas the construction of a seawall will result in the loss of the beach.

Example for Step 3, cont'd

- *Wastewater Treatment Facility:* Given its low adaptive capacity and high sensitivity to higher levels of sea-level rise, the wastewater treatment facility is at high risk. Loss or damage to the facility could result in serious social, economic, and environmental consequences. Flooding of the facility and surrounding areas will cause damage to infrastructure and loss of facility function. This could lead to discharge of untreated sewage, which would have adverse impacts to water quality and could impair the health of nearshore ecosystems. Sea-level rise could also cause outflow pipes to back up with seawater, leading to inland flooding and additional water quality problems. However, efforts to protect the structure may have unintended consequences including loss of surrounding habitat areas.

e. Land Use Planning Options and Constraints

- *Wetland:* The high adaptive capacity of the wetland means that protecting this resource may only mean ensuring that there is space available for it to move into. Land use policies designed to protect areas inland of the current wetland area will be necessary.
- *Bluff-top Residential Development:* The area in question will eventually become incompatible with the current use. Development will not begin to be exposed to sea-level rise impacts until 2050, but it is important to start planning now about how best to protect the houses. Managed retreat will necessitate identifying feasible locations into which houses could be moved or a plan to abandon and remove houses.
- *Wastewater Treatment Facility:* The biggest question in this scenario is the wastewater treatment facility. It should be determined how likely it is that the facility will be able to be protected throughout the rest of its economic lifespan under even the highest sea-level rise scenarios. It may be that the wastewater treatment facility becomes an incompatible use under future conditions. If so, plans should be made to relocate at-risk portions of the facility, as feasible, or to phase out the facility.

Decisions about how to address various challenges presented by sea-level rise will require prioritizing the different resources based on the goals of the community and the various characteristics of each resource. An understanding of the exposure, sensitivity, adaptive capacity, consequences, and requirements for the particular resources and scenarios will need to be kept in mind as managers move into Step 4 to identify possible adaptation strategies.

Step 4 - Identify adaptation measures to minimize risks.

Whether as part of a new LCP or as part of an amendment to update a certified LCP, coastal managers should develop strategies and new or revised land use designations, policies, standards, or ordinances to address sea-level rise impacts.

A LCP as certified by the Commission will already have included land uses policies, standards, and ordinances to implement Chapter 3 policies related to hazard avoidance and mitigation, and may already contain significant hazard policies that may need to be revised to reflect new information and new techniques. The LCP should be evaluated to identify the land use designations policies or ordinances that may need to be amended. A LCP update may need to include a variety of adaptation measures depending on the nature and location of the vulnerability.

The following sections address measures that local governments should consider in their LCPs, organized by category of coastal resource. For each issue area, there is a description of potential impacts that could occur due to sea-level rise, a list of adaptation tools or actions to minimize impacts, and a description of how to update the LCP. To skip to a topic, click on the links below.

- 4.1. [Planning and Locating New Development](#)
- 4.2. [Hazards/ Shoreline Development](#)
- 4.3. [Public Access and Recreation](#)
- 4.4. [Coastal Habitats \(ESHA, wetlands, etc.\)](#)
- 4.5. [Agricultural Resources](#)
- 4.6. [Water Quality](#)
- 4.7. [Archeological and Paleontological Resources](#)
- 4.8. [Scenic Resources](#)
- 4.9. [Energy, Industrial, and other Coastal Development Uses](#)

The following sections present measures that local governments should consider including in their LCPs, organized by category of coastal resource. Additional guidance for developing or updating a LCP can be found in [Appendix C](#) and [Appendix D](#) and should be consulted as part of any update or new LCP process.

4.1 Planning and Locating New Development

Suggested Changes to the LCP:

Certified LCPs should address the kinds, locations, and intensity of uses allowed. The types and locations of uses may need to be revised given increases in coastal hazards due to sea-level rise. For example, land adjacent to wetlands may need to be rezoned to restrict development in order to allow wetlands to migrate inland over time. Also, development policies may need to be updated to reflect new limits on the capacity of public works facilities, such as limiting new development that relies on groundwater resources susceptible to saltwater intrusion. As part of the update, designate sufficient land for priority uses under the Coastal Act to ensure that priority uses will continue to be accommodated over time as sea-level rise occurs.

What should updated development standards include?

- ✓ **Update inventory and maps:** The LCP update should include an updated inventory and map of all land uses, clearly showing areas vulnerable to sea-level rise.
- ✓ **Update land use designations and zoning ordinances:** For any areas that become hazardous due to sea-level rise, establish hazard zones or overlays and update land uses and zoning requirements to minimize risks from sea-level rise.
- ✓ **Convert vulnerable areas to conservation or open space sites:** Update land use designations to establish conservation, open space, or recreation uses in areas where sea-level rise could be an issue. Allow and encourage retirement or transfer of development rights on private property that is subject to sea-level rise.
- ✓ **Limit first floor habitable space:** Where applicable, revise residential building standards to limit first floor habitable space in areas likely subject to flood/wave action.
- ✓ **Limit second units:** In areas subject to erosion, flood, or wave hazards add policies to limit the addition of second units to areas where future protection is not needed and there are no coastal resource impacts, including any future risks due to sea-level rise over the entire life of the primary structure.
- ✓ **Limit subdivisions in areas vulnerable to sea-level rise:** Prohibit any new land divisions, including subdivisions, lot splits, lot line adjustments, and certificates of compliance that

Potential Impacts to Development:

- Development in coastal areas is at increased risk to coastal hazards.
- Property damage due to hazards can impair coastal water quality, sensitive habitat, public access, and other coastal resources.

Actions to Minimize Impacts:

- Limit new development in hazard areas.
- Convert areas vulnerable to sea-level rise to conservation areas or open space.
- Add additional development controls in areas subject to risks from sea-level rise.
- Cluster development away from hazard areas.

create new beachfront or blufftop lots unless lots can meet specific criteria that ensure they are not exposed to hazards or pose any risks to protection of coastal resources.

- ✓ **Consider a shorter development life for constrained lots:** When a lot is not large enough to provide a safe building area for the proposed life of the development without reliance upon protection or impacts to coastal resources, a shorter proposed life could allow development to occur for the short time period that the site can safely support such a use.
- ✓ **Limit or prohibit use of bluff retention or shoreline protection for new development:** LCPs should have policies that require new development to be safe from bluff retreat, waves, or flood hazards without the use of any shoreline protective device. This policy preserves the ability of the shoreline to retreat naturally with changing conditions, which is especially important given projected changes from sea-level rise. LCPs should also require new development in potentially hazardous locations to include a waiver of rights to future shoreline protection.
- ✓ **Ensure that current and future risks are assumed by the property owner:** New development should be undertaken in such a way that the consequences from development in high-hazard areas will not be passed on to public or coastal resources. Establish standards that ensure that current and future risks are assumed by the property owner.
- ✓ **Limit development near vulnerable water supplies:** Limit new development in areas dependent on water supplies susceptible to saltwater intrusion.
- ✓ **Restrict development of new wells:** Require water wells to be sited away from areas where saltwater intrusion could occur. Establish standards for use of sensitive aquifers to reduce risks of saltwater intrusion.
- ✓ **Cluster development:** Concentrate development away from hazardous areas. Update any existing policies that cluster development to reflect additional hazard zones due to sea-level rise.
- ✓ **Redevelopment restrictions:** Limit expansion of non-conforming or other land uses in hazardous areas. For example, require projects that involve significant exterior and/or interior alterations of non-conforming structures to bring the entire structure into conformity with current requirements regarding avoidance and minimization of hazards. Significant alterations can be defined as:
 - Replacement of 50% or more of an existing structure, including but not limited to, demolition of 50% or more of the exterior walls or major structural components, or a 50% increase in floor area.
 - Demolition, renovation or replacement of less than 50% of an existing structure where the proposed remodel would result in cumulative alterations exceeding 50% or more of the existing structure from the date of certification of the LUP.

4.2 Hazards and Shoreline/Bluff Development

Suggested Changes to the LCP:

The hazards section of the LCP will likely need to be updated to ensure hazards from sea-level rise are considered in hazard analyses, siting and design of new development, and to establish programs and policies to address existing development located in high-risk areas. The responses to address hazards due to sea-level rise should have the least impact on coastal resources.

What should the updated component include?

- ✓ **Update land use designations/ zoning:** Update land use designations to limit development within areas subject to hazards from sea-level rise and to encourage removal of threatened development and transfer of development rights away from such areas.
- ✓ **Update development standards:** Establish development standards for properties within sea-level rise zones, such as updated flood protection measures to avoid and minimize flood risks.
- ✓ **Applications for new development in areas where sea-level rise may be a concern should include a site-specific evaluation of sea-level rise:** Update policies, ordinances, and permit application requirements to include an analysis of coastal hazards due to sea-level rise over the full projected life of the structure. Analyses should be conducted by a certified civil engineer with expertise in coastal processes.
- ✓ **Incorporate sea-level rise into calculations of the Geologic Setback Line:** Update geotechnical report requirements for establishing the Geologic Setback Line (bluff setback) to include consideration of bluff retreat due to sea-level rise, in addition to historic bluff retreat data, future increase in storm or El Niño events, and any known site-specific conditions. The report should be completed by a licensed Geotechnical Engineer or an Engineering Geologist.
- ✓ **Include sea-level rise in tsunami hazard assessments:** Sea-level rise should be included in tsunami hazard assessments, including in tsunami wave runup calculations.
- ✓ **Site and design development to minimize risks from sea-level rise:** Update siting and design requirements to ensure development is safe from hazards associated with sea-level

Potential Hazard Impacts:

- Coastal resource impacts due to property damage from flooding and erosion.
- Low-lying roads, wastewater treatment facilities, energy facilities, stormwater infrastructure, potable water systems, and electricity transfer systems are at risk of inundation, flooding, or erosion impacts.
- Increase in number of people and structures exposed to flooding from a 100-year flood event.
- Increase in instability of structures and recreation areas exposed to erosion.
- Overtopping or damage of levees.

Actions to Minimize Impacts:

- Limit development in hazard areas.
- Add additional development controls in areas subject to risks from sea-level rise. These may expand the existing areas where flood and erosion policies apply.
- Site and design development to avoid or minimize hazards due to sea-level rise.
- Include sea-level rise in tsunami wave runup calculations.

rise for the full projected life of the structure, without the use of shoreline protective devices. If it is not feasible to site development away from hazards, elevate above the base Flood Elevation (as defined by FEMA) adjusted for projected sea-level rise, and setback as far landward as possible.

- ✓ **Increase setback requirements:** Require new structures to be set back a sufficient distance landward to minimize risks, to the maximum extent feasible, over the life of the structure. For blufftop development, ensure development is set back from the bluff edge far enough that it will not be endangered by erosion, including sea-level rise over the life of the structure, without the use of any shoreline protective device, to the maximum extent feasible. The permit for new development should require it to be removed or relocated if it becomes threatened in the future.
- ✓ **Protect function of critical facilities:** Ensure critical facilities are able to function given sea-level rise. Use the upper range of sea-level rise as a minimum for siting and design of critical facilities. Consider developing a plan for relocation or retrofit of existing facilities located in hazardous areas.
- ✓ **Site and design wastewater disposal systems to avoid risks from sea-level rise:** Ensure wastewater disposal systems are not adversely affected by the effects of sea-level rise over the full life of the structure.
- ✓ **Require “soft” or “living” shorelines:** On appropriate shorelines, require new development to use “soft solutions” or “living shorelines” as an alternative to the placement of shoreline protection to enhance natural resource areas, dune restoration, sand nourishment, etc.
- ✓ **Consider a shorter development life for constrained lots:** When a lot is not large enough to provide a safe building area for the proposed life of the development without reliance upon protection or impacts to coastal resources, a shorter proposed life could allow development to occur for the short time period that the site can safely support such a use.
- ✓ **Ensure that current and future risks are assumed by the property owner:** New development should be undertaken in such a way that the consequences from development in high-hazard areas will not be passed on to the public or coastal resources.
- ✓ **Prohibit use of bluff retention or shoreline protection for new development, with the exception of coastal-dependent uses:** LCPs should have policies that require new development to be safe from bluff retreat, waves, or flood hazards without the use of any shoreline protective device. This policy preserves the ability of the shoreline to retreat naturally with changing conditions, which is especially important given projected changes from sea-level rise. LCPs should also require new development in potentially hazardous locations to include a waiver of rights to future shoreline protection. Shoreline protection is allowable for coastal-dependent uses under Coastal Act Section 30235.
- ✓ **Add conditions to shoreline protective devices that limit authorization of the device to the life of the existing development being protected:** The LCP can establish policies

stating that permits for shoreline protective devices should be limited to the life of the existing development the protection device is designed to protect. At the end of that time period, the continued need for the structure should be re-evaluated and, if it is retained, appropriate mitigation for future effects should be required.

- ✓ **Require property owners to waive the right to shoreline protection in the future:** The LCP should require new development in potentially hazardous locations to include a waiver of the property owners' right to shoreline protection in the future.
- ✓ **Require mitigation for impacts of shoreline structures:** For unavoidable public resource impacts from shoreline structures permitted under the Coastal Act, require mitigation of resource impacts over the life of the structure as a condition of approval for the development permit. For example, for the loss of sandy beach due to shoreline protection devices, require landowners to pay a sand mitigation fee or complete other commensurate mitigation actions.
- ✓ **Develop an incentive program to relocate existing development at risk:** Provide incentives to relocate development out of hazardous areas and to acquire oceanfront properties damaged by storms, where relocation is not feasible. Consider creating a relocation fund through increased development fees, in lieu fees, or other funding mechanisms.
- ✓ **Establish a transfer of development credits program:** Consider creating a transfer of development credits program (TDC) or lot retirement program where new development located in hazardous areas must pay a fee or purchase development rights of properties identified by the land use plan to be in high-hazard sea-level rise zones or key conservation areas for wetland migration.
- ✓ **Develop or update shoreline management plans to address long-term shoreline change due to sea-level rise:** Create policies that require areas subject to wave hazards and erosion to develop a management plan, including strategies to manage changes in wave, flooding, and erosion hazards due to sea-level rise.
- ✓ **Establish a beach nourishment program and protocols:** New policies may be needed to address increased demand or need for beach nourishment with sea-level rise. Policies could establish a beach nourishment program and protocols for conducting beach nourishment, including measures to minimize adverse biological resource impacts from deposition of material, including measures such as timing or seasonal restrictions and identification of environmentally preferred locations for deposits.
- ✓ **Establish a sea-level rise planning and research program:** Add policies that establish actions to conduct long-term sea-level rise monitoring and research on areas of key uncertainties.

4.3 Public Access and Recreation

Suggested Changes to the LCP: Certified LCPs should already have policies and standards to assure that existing public access is protected and that maximum public access to and along the shoreline is both planned for and provided with new development when warranted. The LCP should also contain policies to maximize access to recreation and visitor serving facilities as a priority use under the Coastal Act. These policies may need to be updated to minimize impacts to public access, recreation sites or visitor-serving facilities due to sea level-rise.

What should the updated component include?

- ✓ **Update inventory and maps:** The LCP should include an updated inventory and maps of existing public access areas, recreation sites, and visitor-serving facilities at risk from sea-level rise, including:
 - Vertical accessways
 - Beaches
 - Sections of the California Coastal Trail
 - Any other recreation sites or related structures, including parking lots or boat ramps
 - Areas suitable for new public accessways, parks and open space.
- ✓ **Update land use designations and zoning ordinances:** Update land use designations and zoning ordinances as applicable to provide for additional access, parklands, trail locations, recreation facilities, visitor-serving accommodations, etc. Establish land use standards to ensure an appropriate mix of visitor-serving accommodations over time.
- ✓ **Site and design access sites and facilities to minimize impacts:** Add policies that require public access sites, segments of the CCT, recreation and visitor-serving facilities to be sited and designed to avoid impacts from sea-level rise, while maximizing public access and recreation opportunities. Where facilities can be safely sited for the near term but

Potential impacts to Public Access and Recreation:

- Vertical accessways could become inaccessible.
- Loss of sandy beach area, including loss of lateral access
- Sections of the Coastal Trail could become eroded and inaccessible.
- Boat launch areas could become flooded and inaccessible.
- Loss of parks or recreation areas.
- Loss of visitor-serving facilities if threatened by sea-level rise.
- Loss of recreation opportunities, including change in surfing conditions, etc.
- Damage to structures that support recreation – picnic tables, restrooms, parking lots, etc.
- Increased demand for shoreline armoring projects to protect existing development with negative impacts on coastal access and recreation.

Actions to minimize impacts:

- Retrofit or relocate vertical accessways.
- Relocate or retrofit sections of the Coastal Trail through boardwalks, bridges, or other design features.
- Establish new accessways.
- Develop a sediment management and sand replenishment strategy.
- Plan for removal of structures that limit inland migration of beaches.
- Plan for future coastal recreational space and parkland by protecting existing open space adjacent to the coast.
- Retrofit or relocate recreation and visitor-serving facilities.
- Establish new recreation and visitor-serving facilities.
- Establish incentives for creation of new recreation opportunities, facilities and businesses.

future impacts are likely, require an adaptive management plan detailing steps for maintenance, retrofitting, and relocation.

- ✓ **Plan ahead to replace loss of visitor-serving accommodations:** Develop a plan to replace any visitor-serving accommodations that are lost due to impacts from sea-level rise, ensuring continued provision of affordable options, and an appropriate mix of accommodations over time.
- ✓ **Add requirements for retrofit/relocation of public access sites at risk:** The LCP can add policies that require all new public access and recreation areas, sections of the CCT, visitor-serving accommodations, or related recreation facilities to be retrofitted or relocated if they become threatened from erosion, flooding, or inundation. For facilities and public access sites located on private property, the requirements can be implemented through conditions of approval for new development that specify how maintenance, retrofit, or relocation will take place.
- ✓ **Require mitigation of any unavoidable impacts:** For unavoidable impacts to public access or recreation from shoreline armoring or other development, require mitigation of impacts through the addition of new public access, recreation opportunities, visitor-serving accommodations or Coastal Trail segments.
- ✓ **Incorporate sea-level rise into a comprehensive beach management strategy:** Update or develop a new comprehensive beach management strategy to address loss of beach areas, including loss of lateral access, or changes in beach management due to sea-level rise. Establish a program to minimize loss of beach area through, as may be appropriate, a beach nourishment program, restoring sand and sediment supply to littoral cell, removal or adjustments to shoreline protection structures, or other actions.
- ✓ **Support research on unknown impacts to recreation and public access:** Changes in sea level will affect wave conditions and sediment transport, but additional research is needed to understand how these changes will affect specific conditions for surfing and other recreation activities. To the extent possible, add policies to promote research on sea-level rise impacts to surfing or other recreation activities in the LCP jurisdiction.
- ✓ **Add policies to address impacts to transportation routes:** If transportation facilities are at risk from sea-level rise, establish new alternative transportation routes, or a plan to ensure continued alternative transportation and parking is available.

4.4 Coastal Habitats (ESHA, Wetlands, etc.)

Suggested Changes to the LCP:

LCPs should already have policies to protect ESHA, wetlands, riparian areas, and other natural resources in the coastal zone. Any existing policies should be evaluated to determine the extent to which the policies already address changes from sea-level rise. Additional policies may be needed to limit development in areas upland of wetlands, wildlife corridors, and important habitat linkages; to increase the size of buffer zones between development and natural resource areas; and to establish adaptive management plans for natural resource areas that account for sea-level rise.

What should the updated component include?

- ✓ **Update inventory and maps:** The updated LCP should include maps of existing wildlife corridors, habitat types and linkages, and natural resource areas; as well as maps of potential ecosystem change over time with sea-level rise. These maps can be generated through modeling with programs such as SLAMM (See [Appendix D](#) for a description). The LCP should also include an inventory of areas where habitats can migrate inland and where barriers exist that prevent migration. The LCP should also allow for the protection of wetlands and other coastal habitats that have not yet been mapped or identified.
- ✓ **Update land use designations and zoning to protect land adjacent to sensitive habitats:** Update land use designations and zoning to limit development in areas where coastal habitats could migrate inland as sea level rises.
 - ✓ **Cluster development away from coastal habitats:** Existing LCPs will likely have policies that already require clustering of development. To address sea-level rise, these policies might need to be updated to include clustering development away from land where wetlands and other coastal habitats could migrate with sea-level rise.
 - ✓ **Limit subdivisions:** Update subdivision requirements to limit any new land divisions, including lot line adjustments, in areas where natural resource areas could migrate inland or to require lots to be configured in a way that allows such migration.

Potential impacts coastal habitats:

- Conversion and loss of habitats as intertidal zones shifts inland.
- Loss of wetland habitat where inland/upslope migration of habitat cannot keep pace with sea-level rise due to natural or anthropogenic barriers.
- Loss of sandy beach habitat, haul-out sites, nesting habitat, nursery areas for fish, and migratory bird habitat.
- Rapid increase in the retreat rate of dunes.
- Potential loss of rare plants.
- Salinization and saltwater intrusion.

Actions to minimize impacts:

- Protect wildlife corridors, habitat linkages, and land upland of wetlands to allow habitat migration.
- Increase size of buffer zones.
- Restore natural sediment sources to wetlands.
- Update habitat management plans to address sea-level rise.
- Use an adaptive management approach in ecosystem restoration or design.
- Establish conservation easements to protect habitat.
- Cluster development away from habitat areas.
- Connect habitats to allow species movement.
- Protect refugia areas.

- ✓ **Consider sea-level rise buffer zones:** Update buffer zone policies to allow room for coastal habitats to migrate with changes in sea level. Buffer size will depend on site-specific factors including natural and artificial landform features. For instance, in flat areas, a larger buffer may be needed, but in steep areas, a smaller buffer would be acceptable.
- ✓ **Include sea-level rise in site-specific evaluations:** Update policies to require site-specific biological evaluations and field observations of coastal habitat to include an evaluation of vulnerability to sea-level rise. Such an evaluation should consider both topographic features as well as habitat and species sensitivities (for example, sensitivity to inundation and saltwater intrusion).
- ✓ **Update policies to provide for new or restored coastal habitat:** Update policies to require new coastal habitat to be provided or degraded areas to be restored to account for the expected loss of existing habitat that will occur with sea-level rise, using an adaptive management approach where applicable. Consider including a “no-net loss” of coastal habitat types as an LCP policy.
- ✓ **Update requirements for coastal habitat management plans:** Add policies stating that the effects of sea-level rise should be addressed in management plans for coastal habitats. Management plans should evaluate the full range of sea-level rise impacts to coastal habitats, and develop a strategy for managing coastal habitats given changing sea-level rise conditions. The plan should establish an adaptive management approach, with clearly defined triggers for adaptive actions. Existing management plans may need to be updated to add new monitoring and restoration requirements to address sea-level rise.
- ✓ **Updating monitoring requirements for coastal habitats:** As part of the LCP, consider establishing a monitoring protocol and requirements for evaluating sea-level rise impacts to coastal habitats over time.
- ✓ **Require open space protection as a component of new development located adjacent to coastal habitats:** In certain areas, the LCP can require as a permit condition that new development protect buffers around natural resource areas through a conservation easement, deed restrictions, or other comparable mechanism. Consider using rolling conservation easements that move inland over time to allow habitat to shift with sea-level rise.
- ✓ **Identify areas for public acquisition:** The LCP can establish a program to partner with state, federal, and non-profit organizations to acquire and protect natural resource areas for public use, including areas that could serve as refugia for species impacted by sea-level rise, or areas that could be appropriate sites for coastal habitat creation or restoration.
- ✓ **Pursue strategies to protect ecosystem function under a range of future sea-level rise or climate change scenarios:** The LCP can recommend coastal habitat management strategies that strive to protect ecosystem function in the future. Strategies include protecting a wide range of ecosystem types, protecting refugia, protecting wildlife and habitat corridors, and establishing methods to monitor ecosystem change over time.

- ✓ **Identify opportunities for Regional Sediment Management:** Sediment supplies will be important for the long-term sustainability of many beaches and wetland areas. Strategies to maintain or restore natural sediment supplies and to coordinate sediment removal efforts with opportunities for reuse, can provide multiple benefits to coastal ecosystems.

4.5 Agricultural Resources

Suggested Changes to the LCP:

The existing LCP should have policies to protect agriculture as a priority use in the Coastal Zone. Agriculture policies may need to be updated to address saltwater intrusion in coastal aquifers on agricultural lands and to identify additional areas for agriculture to replace any areas lost to sea-level rise.

What should the updated component include?

- ✓ **Update inventory and maps:** The updated LCP should include an updated inventory and map of all prime and non-prime agricultural areas, showing vulnerability of areas to sea-level rise.
- ✓ **Limit conversion of non-prime agricultural land:** Anticipate areas that could become more difficult to farm and identify strategies to avoid or mitigate the potential impacts. Develop policies to assure maximum protection of rural agricultural land, open space, and other coastal resource values.
- ✓ **Establish incentives for conservation easements:** Encourage conservation easements in areas vulnerable to sea-level rise. Easements could allow conversion of agricultural land to marsh where appropriate.
- ✓ **Add policies to address saltwater intrusion:** Add policies to manage water supply issues resulting from saltwater intrusion, such as limits on groundwater withdrawal or diversification of water supplies.
- ✓ **Include sea-level rise in water quality protection policies:** Where needed, add policies to reduce water pollution from runoff should agricultural lands become flooded or inundated due to sea-level rise.

Potential Impacts to Agriculture:

- Increase in flooding and inundation of low-lying agricultural land.
- Saltwater intrusion into water supplies.
- Decrease in the amount of freshwater available for agricultural uses.
- Crops may no longer be suitable for areas.
- Economic losses from damage to crops.
- Diversification of water supplies
- Loss of natural flood protection.

Actions to Minimize Impacts:

- Identify and rezone areas suitable for future agricultural production to replace areas lost to sea-level rise.
- Limit conversion of agricultural land to other uses.
- Encourage conservation easements for areas vulnerable to sea-level rise.
- Reduce pumping and avoid overdraft in coastal aquifers.
- Relocate wells and water intake facilities.
- Identify alternate water sources for agriculture.
- Maximize water conservation
- Minimize water quality impacts from flooding of agricultural lands
- Maintain dunes and other natural flood protection

- ✓ **Include policies to protect agricultural barriers:** If coastal dunes provide the main flood protection for agricultural lands, add policies to encourage long-term sustainability of the dune systems.

4.6 Water Quality

Suggested Changes to the LCP:

Certified LCPs should include policies to reduce nonpoint source pollution, including policies to minimize introduction of pollutants, minimize increases in peak runoff rate, restore impaired waters, incorporate effective site design and source control using Best Management Practices (BMPs), preserve functions of natural drainage systems, minimize impervious surfaces, and facilitate the infiltration of runoff. In addition to controlling polluted runoff, these policies will also help mitigate the impacts of sea-level rise. The updated LCP should evaluate whether new policies will be needed to minimize any additional impacts on water quality due to inundation of ocean outfalls, saltwater intrusion into water supplies, and potential increases in nonpoint source pollution.

The LCP should continue to promote principles of low impact development, protection and expansion of pervious surfaces, and implementation of other BMPs that reduce nonpoint pollution and increase infiltration of stormwater.

What should the updated water quality section include?

- ✓ **Clearly define areas at risk:** The LCP should include an updated inventory of potential pollutant sources due to sea-level rise, including toxic waste sites, ocean outfalls and wastewater treatment facilities at risk of inundation, as well as aquifers and wells at risk of saltwater intrusion.
- ✓ **Add policies to address water quality risks from ocean outfalls:** Consider establishing a program to retrofit or relocate ocean outfalls deemed at risk.
- ✓ **Add policies to address saltwater intrusion in aquifers:** Consider adding policies that establish a long-term strategy for addressing saltwater intrusion in aquifers, including limiting the use of sensitive aquifers as applicable. For some areas of the state, additional information is needed on the site-specific impacts of sea-level rise on aquifers. For these areas, the LCP could promote the establishment of a research program to increase understanding of the vulnerability of coastal aquifers.

Potential impacts to water quality:

- Increase in nonpoint source pollution from flooding and inundation of impervious surfaces, industrial sites, or toxic soils.
- Ocean outfalls could become inundated with seawater and backflow, causing inland flooding of polluted water.
- Saltwater intrusion into water supplies.

Actions to minimize impacts:

- Retrofit or relocate outfalls deemed “at risk”.
- Reduce pumping and avoid overdraft in coastal aquifers.
- Relocate wells and water intake facilities.
- Identify and remediate toxic soils and contaminated sites at risk from sea-level rise.
- Conduct research and monitoring to more precisely understand local issues.

- ✓ **Update water quality Best Management Practices:** Evaluate and update BMPs to account for changes in water quality issues due to sea-level rise, as applicable.
- ✓ **Update siting and design policies:** Add policies to ensure that new ocean outfalls, wastewater treatment facilities, and other facilities that could negatively impact water quality if flooded or inundated are sited and designed to minimize impacts from sea-level rise.

4.7 Archeological and Paleontological Resources

Suggested Changes to the LCP:

The existing LCP should have policies that specify requirements for maintaining information on the location of the known and suspected locations of archaeological and paleontological resources in the coastal zone, as well as how to proceed if resources are uncovered during the development process.

What should the updated component include?

- ✓ **Update inventory and maps:** Update file of known and suspected resources, showing any potential risks from sea-level rise. File should be kept confidential in order to prevent vandalism to sites. Consult with tribal groups.
- ✓ **Add policies to protect archeological and paleontological resources from sea-level rise:** Add policies to require site-specific evaluation of potential sea-level rise impacts to archeological and paleontological resources on a development site. If resources are at risk, the appropriate entity or Native American tribes should be contacted to develop a management plan for artifacts. The LCP can also add requirements that a monitoring program and plan be established as a condition of approval for development located on a site with artifacts vulnerable to sea-level rise.

Potential Impacts to Archeological and Paleontological Resources:

- Damage to resources from erosion or flooding.

Actions to Minimize Impacts:

- Consult with relevant tribes for guidance.

4.8 Scenic Resources

Suggested Changes to the LCP:

Certified LCPs should have policies that protect scenic resources. Many have addressed scenic resources through the designation of special communities, such as a historic community. Some adaptation measures may adversely affect public views of coastal areas or degrade the visual character of special communities. LCPs should include policies to protect scenic resources.

What should the updated component include?

- ✓ **Update inventory and maps:** Update inventory and maps of scenic areas and identify any that are in areas that could be affected by sea-level rise or adaptation measures.
- ✓ **Update land use designations and zoning ordinances:** Consider updating zoning requirements to avoid or minimize adaptation measures (such as elevation of structures to address flooding) that might result in adverse impacts to scenic resources or community character.
- ✓ **Establish design standards to protect visual resources:** Update design standards to ensure that adaptation measures protect visual resources while minimizing hazards

Potential Impacts to Scenic Resources:

- Elevation of structures to minimize flood risk could have scenic resource impacts.
- Increased demand for shoreline armoring to protect existing structures, with negative impacts on visual resources.

Actions to Minimize Impacts:

- Develop or redevelop property to be safe from hazards without impairing scenic resources.
- Establish new scenic communities in areas where significant visual resources could be diminished from adaptation responses (i.e. due to seawalls or spider homes).
- Add design standards to protect visual resources while minimizing hazards.

4.9 Energy, Industrial, and other Coastal Development

Suggested Changes to the LCP:

What should the updated component include?

- ✓ **Update inventory and map:** Update inventory and maps of existing energy facilities and coastal dependent industries within the coastal zone, showing areas likely to be affected by sea-level rise.
- ✓ **Update land use designations:** Update land uses as needed based on sea-level rise impacts and compatible uses.
- ✓ **Include sea-level rise in all actions related to energy, industrial:** Include policies to require industrial and energy facility expansion plans and proposals to include sea-level rise.

Potential impacts to Energy, Industrial and other Coastal Development

- Property damage from flooding and erosion due to sea-level rise
- Impaired function of facilities
- Potential need for decrease in dredging in marinas.
- Potential difference in heights between ships and cargo handling facilities and drydock/ship repair facilities.

Actions to minimize impacts:

- Design facilities to incorporate sea-level rise.
- Update land uses where applicable.
- Relocate or redesign existing facilities at risk.

***Expected outcomes from step #4:** Identified sections of the LCP that need to be updated, a list of adaptation measures applicable to the LCP, and new policies and ordinances to implement the adaptation measures.*

Step 5 – Update or Develop LCP and Certify with the Coastal Commission.

The next step is to incorporate the LCP policies that address sea-level rise into a new LCP or an updated LCP amendment. For jurisdictions with a certified LCP, adaptation measures will be implemented through development of amendments to the certified LCPs. For jurisdictions that currently do not have a certified LCP, the sea-level rise policies will be part of the development of a new LCP. In areas without a certified LCP, the Coastal Commission retains permitting authority, and the standard of review for any development is the California Coastal Act. Thus, it is important for local governments without certified LCPs to complete the planning and certification process.

As noted in step 4, sea-level rise has the potential to affect many types of Coastal Act resources in an LCP planning area/segment, and it is likely that policies in each Chapter of the LCP will need to be revised or developed to address impacts from sea-level rise. Two major types of updates to the LCP will likely be needed to address sea-level rise:

1. New or revised policies/ordinances that apply to all development in the planning area. For example, policies such as “All new development should be sited and design to minimize risks from sea-level rise over the life of the structure.”
2. Updated land use and zoning designations, as well as programs to facilitate adaptive community responses, to reduce risks to specific coastal resources. For example, the LCP could modify the zoning of undeveloped land located upland of wetlands from residential to open space in order to provide the opportunity for wetlands to migrate inland, and protect wetlands for the future.

Local government staff should work closely with Coastal Commission staff and relevant stakeholders to develop the new LCP or LCP amendments. Once the updates and plans are complete, local governments will submit to the Commission for certification. Certification of plans can be an iterative process. Many times the Commission will approve a plan with modifications, at which point the local government is required to complete the modifications and resubmit to the Commission for final certification within a certain period of time.

Step 6 - Monitor and revise as needed.

An important component of successful adaptation is to regularly monitor progress and results, and update any policies and approaches as needed. Sea-level rise projections should be evaluated at least every five years.

- **Identify key resources to monitor:** Certain species can be indicators of whether sea-level rise is affecting an ecosystem. For instance, the presence of certain species can indicate the salinity of soils.

- **Periodically Update LCPs:** Local governments should try to review their vulnerability and risk assessments on a regular basis as significant new scientific information becomes available and propose amendments as appropriate. Given the evolving nature of sea-level rise science, policies may need to be updated as major scientific advancements are made, changing what is considered the best available science. Regular evaluation of policies is important to make sure policies and adaptation strategies are effective in reducing impacts from sea-level rise.

This six-step process is illustrated below in the flowchart ([Figure 5](#)). Notice that the process is circular. Because sea-level rise science will be refined and updated in the future, planners should periodically repeat this six-step process to update and improve their LCPs.

For additional resources and examples of ways to incorporate sea-level rise into the LCP, see [Appendix C](#).

Planning Process for Local Coastal Programs and Other Plans

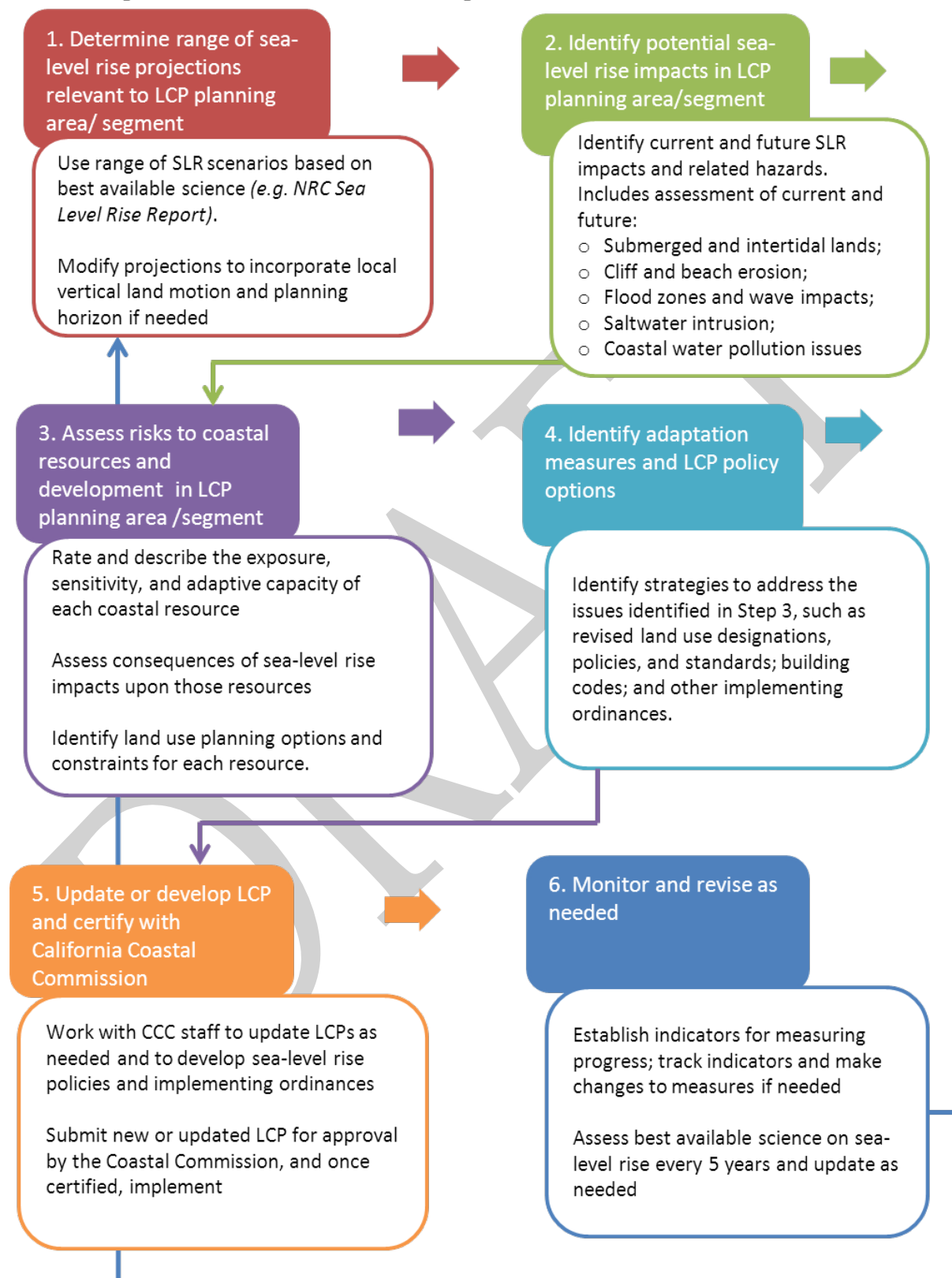


Figure 5. Flowchart for Addressing Sea-Level Rise in Local Coastal Programs and other Plans